

NERL Research Abstract

EPA's National Exposure Research Laboratory

GPRA Goal 5 - Safe Waste Management

APM # 572

Significant Research Findings

Expanding the Framework for Risk Analysis in Multimedia Environmental Systems- Hazardous Waste Identification Rule (FRAMES-HWIR) Technology Software System Technical Design

Purpose

In December 1995 EPA proposed to amend existing regulations for disposal of hazardous wastes under the Resource Conservation and Recovery Act (RCRA). This proposal outlined the new Hazardous Waste Identification Rule (HWIR) that was designed to establish constituent specific exit levels for low risk solid wastes. Wastes applicable under HWIR were those designated as hazardous because they were listed, or had been mixed with, derived from, or contained the listed wastes. Under the HWIR proposal, waste generators of listed wastes that could meet the new exit level criteria defined by the HWIR methodology, would no longer be subject to the hazardous waste management system specified under Subtitle C of RCRA for those wastes. Basically, this established a risk based "floor" for low risk hazardous wastes that would encourage pollution prevention, waste minimization, and the development of innovative waste treatment technologies. The purpose of the rulemaking was to reduce possible overregulation arising from the older "mixture" and "derived-from" rules promulgated earlier. Note that, in a number of cases, wastes were listed on the basis of containing both toxic hazardous constituents and exhibiting one or more of the hazardous waste characteristics that do not relate to chemical toxicity (e.g., ignitability, corrosivity, reactivity). If such a waste still exhibits any characteristic after complying with the exemption criteria proposed in the HWIR, it must continue to be managed as a characteristically hazardous waste.

The mixture rule and the derived-from rule were promulgated as part of the first comprehensive regulatory program for the management of hazardous wastes under RCRA in May 1980. The mixture rule defined as a hazardous waste any solid waste that is mixed with one or more listed wastes, and the derived-from rule labeled as hazardous waste any solid waste generated from the treatment, storage or disposal of a listed hazardous waste. Both were, and still are,

considered important definitions in regulating the disposal of hazardous wastes consistent with reducing risk to human health and the environment. However, since they apply regardless of the concentrations or mobilities of hazardous constituents associated with the solid wastes, the potential for over-regulation is a possibility.

The primary purpose of this effort is to perform final testing of the system software (including the Site Layout Processor, Site Definition Processor, Chemical Properties Processor, System User Interface, Multimedia Multipathway Simulation Processor, Exit Level Processor I, and Exit Level Processor II/Risk Visualization Processor).

Research Approach

The approach to final testing of the system software involves the following steps.

1. The software developer will deliver the module executable, source code, test plan, and testing results documentation to an external independent test group.
2. The external independent test group critically reviews the developer's test plan for completeness.
3. The external independent test group documents additional tests to be conducted (if necessary).
4. The external independent test group (re)executes all tests and any additional tests using the delivered program executables.
5. Working iteratively, the external independent test group documents any errors found and communicates with the software developer. The software developer corrects code and redelivers the executable and source code to the external independent test group to continue testing.
6. The external independent test group recompiles source code(s) and rebuilds the executable files.
7. The external independent test group (re)executes the tests conducted under Step 4 using the new executable files. The iteration with the module developer, as described in Step 5, is repeated until all test results are acceptable, or it is decided that the remaining problems do not require fixing.

Major Findings and Significance

Independent testing of all software components has been successfully completed. The final step, system software testing is underway and will be completed in September, 2000 for this GPRA Goal 5 APM #572 (Expand FRAMES-HWIR Technology Software System Technical Design to address small watershed scale multimedia modeling needs under RCRA, Superfund, CAA, and CWA and provide initial prototype of MIMS).

**Research
Collaboration
and
Publications**

The HWIR effort described herein represents the combined efforts of the Office of Research and Development (ORD) and the Office of Solid Waste (OSW). OSW was primarily responsible for the development of the HWIR methodology, databases, and numerous individual modules representing aspects of a multimedia risk assessment (e.g., watershed module, ecological exposure module). ORD was primarily responsible for the design of the software framework system (design and implementation) and many individual modules (e.g., atmospheric module, surface water module). Both ORD and OSW shared responsibility for organizing the comprehensive peer review required for HWIR.

The following list of titles has been developed describing the FRAMES-HWIR software system design (ORD's primary responsibility) and are available. These documents contain all descriptions of software tests referred to above.

Documentation for the FRAMES-HWIR Technology Software System, Volume 2: System User Interface.
Documentation for the FRAMES-HWIR Technology Software System, Volume 4: Site Definition Processor.
Documentation for the FRAMES-HWIR Technology Software System, Volume 6: Multimedia Multipathway Simulation Processor.
Documentation for the FRAMES-HWIR Technology Software System, Volume 7: Exit Level Processor.
Documentation for the FRAMES-HWIR Technology Software System, Volume 8: Specifications.
Documentation for the FRAMES-HWIR Technology Software System, Volume 9: Software Development and Testing Strategies.
Documentation for the FRAMES-HWIR Technology Software System, Volume 10: Facilitating Dynamic Link Libraries.
Documentation for the FRAMES-HWIR Technology Software System, Volume 11: System User's Guide.
Documentation for the FRAMES-HWIR Technology Software System, Volume 12: Contextual Dictionary.
Documentation for the FRAMES-HWIR Technology Software System, Volume 13: Chemical Properties Processor.
Documentation for the FRAMES-HWIR Technology Software System, Volume 14: Site Layout Processor.
Documentation for the FRAMES-HWIR Technology Software System, Volume 15: Risk Visualization Processor and Exit Level-II Processor.

**Future
Research**

The HWIR methodology and technology will continue to be modified to address specific needs in the context of multimedia modeling at the site and watershed scale. Specific science-based additions and enhancements that are either underway or will soon be implemented for RCRA-based regulatory needs include

1. modifications to support risk analysis in the context of the OSW Surface Impoundment Study,

2. implementation of uncertainty assessment methods, and
3. developing a user interface that will facilitate data entry for site-specific assessments. When these enhancements are completed this product will represent a base technology with which to perform both regulatory-based assessments and research-based modeling experiments.

Further, FRAMES-HWIR represents a prototype technology (i.e., testing ground) in the Ecosystems Research Division's long-term vision related to MIMS (Multimedia Integrated Modeling System) and as such will incorporate new software designs as they evolve in MIMS. The next step is to implement a core data exchange protocol from the MIMS design into the FRAMES design. The data exchange protocol (implemented via a Application Programming Interface - API) resides at the core of the software system and establishes how data will be exchanged among models and databases contained in the software system.

Inquiries about expanding FRAMES-HWIR technology may be directed to:

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